The straight line of the relationship between 3-MG and Na transport starts close to the origin of the coordinates (Figure 1). This agrees with the well-known fact that 3-MG is a non-metabolized sugar and means that its uptake corresponds to the transported amount across the intestinal wall.

As far as the intracellular sugar concentration is concerned (Table), we can see that it is always lower than that of the lumen and the serum.

If we assume that the non-absorbing cells of the intestinal epithelial layer are not the most part of the epithelial cells and that the intracellular concentration in these cells of non-metabolizable sugars (3MG) is not too much lower than the blood concentration, a sugar concentration lower than that of the serosal space also in the absorbing cells, must be admitted.

This fact seems to demonstrate that in the in vivo experiment sugars enter the cell downhill and that they are pumped out towards the subepithelial serosal space by an active mechanism. The apparent absence of an intracellular sugar accumulation was postulated by other authors[2]. Therefore, Na asymmetry between the two sides of the brush border in vivo could be responsible of an enhanced entrance of sugars but not of their uphill accumulation.

The drag effect of net water flux on sugars at the level of the serosa facing membrane, as suggested by Crane[4], can be presumably disregarded because of the low passive permeability of sugars[10].

The lower intracellular sugar concentration in in vivo experiment could be due to the fact that the sugar extrusion into the serosal space is higher in this condition than in the in vitro one. As a matter of fact the transepithelial glucose transport in the isolated intestine at the optimum temperature of 28 °C is only a fraction[11] of that found in vivo. Also the Na pump is noticeably lower[11] in vitro in comparison with the in vivo condition.

Riassunto. Nell'intestino tenue di ratto in vivo è stato osservato che la concentrazione intracellulare di glucosio o di 3-*O*-metilglucosio, durante l'assorbimento di questi zuccheri, è sempre minore che nel siero. Ciò lascia presumere che esista una pompa per l'estrusione degli zuccheri a livello della membrana serosale delle cellule assorbenti intestinali.

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Heart Tissue Catecholamines in the Grey *Ratus norvegicus*[1]

Albino rats submitted to long term exercise were reported to develop heart hypertrophy if the exercise was repeated daily[2-5]. No such hypertrophy could be detected in the intermittent physical training[6,7]. The 'athletic' animals were reported to have bradycardia[8], increased cardiac tissue acetylcholine content[9], and a decreased heart tissue catecholamine concentration[7]. These elements were obtained by exercizing the albino laboratory rats in artificial conditions such as running on a threadmill, in a rotating cage or by swimming.

To our knowledge, no studies have been performed dealing with the heart sympathetic neurotransmitter content of the wild grey *Ratus norvegicus*. It was felt to be interesting to examine the effects of exercise and activity resulting from a normal psychological motivation such as would occur in the wild grey rats, and to compare these results with the same species of animals living in confined conditions.

Materials and methods. Wild young male and female grey *Ratus norvegicus* weighing approximately 50 g were caught in traps. They were housed in laboratory cages, fed with standard food and received water ad libitum. They lived in colonies and were submitted to 10 h of light and 14 h of darkness a day. All sensory and emotional

Table I. Values of body weight, heart weight, and heart: body weight ratio in wild and lab *Ratus norvegicus*

	Wild	Lab	*F* ratio
No. of animals	15	17	
Body weight (g)	276 ± 22	292 ± 21	0.28
Heart weight (mg)	988 ± 158	914 ± 58	0.56
Heart: body weight ratio × 100	3.498	3.260	4.47

Values are means ± S.E.M

Table II. Heart weight, tissue catecholamines and proteins in wild and lab *Ratus norvegicus*

	Wild	Lab	*F* ratio
No. of animals	10	16	
Catecholamines (μg/g)	0.498 ± 0.031	0.709 ± 0.039	14.55
Total heart catecholamines (μg)	0.452 ± 0.033	0.639 ± 0.044	9.02
Heart proteins (mg/g)	73 ± 0.02	72 ± 0.01	0.002
Heart weight (mg)	911 ± 77	914 ± 57	0.0009

Values are means ± S.E.M.

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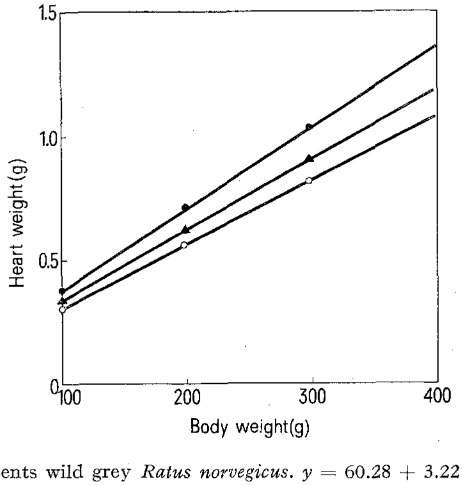
stresses to the animals were avoided as much as possible. After a patient adaptation period we obtained parturiant females. The offspring were reared partly by the grey rats, others by the wistar albino rats. The young males became the experimental animals. They were treated in the same manner as the albino rats, lived in small sex-segregated colonies and lost almost all fear of human presence. Nevertheless, their basic characteristics as to their excitability and savageness still remained. When the weight convenient for the experiments was reached, the animals were taken by the tail when quiet, sacrificed by a knock on the head and immediately decapitated. We shall refer to this first group of experimental animals as lab grey *Ratus norvegicus*. We compared this first group to a series of 14 albino wistar rats sacrificed in the same manner.

A second group of animals consisted of wild male grey *Ratus norvegicus*. As soon as caught intact in the traps, they were killed by a knock on the head followed instantly by decapitation. Heart tissue samples were treated and assayed for catecholamines and proteines as described elsewhere[7,10,11]. Statistical analysis was performed according to SNEDECOR[12]. Differences were considered statistically significant for a P value < 0.05.

Results. The values depicted in Table I were obtained from 15 wild and 17 male lab grey rats. The mean body weight and mean heart weight of both groups were identical. However, the mean heart of body weight ratio differed significantly ($F = 4.47$). The correlation coefficient of the heart to body weight relationship was 0.996 for the lab rats and 0.913 for the wild ones. A covariance analysis (Figure) indicated that the heart weights were significantly different between the groups, not by slope ($F = 3.76$) but by elevation ($F = 10.87$).

In the 14 albino rats the heart catecholamine content amounted to 0.772 ± 0.036 µg/g and 0.597 ± 0.038 µg/total organ. According to the values in Table II, we may consider that the grey lab rats raised in the same conditions as the common albino laboratory rat has an identical catecholamine content ($F = 1.4$). However, as seen in Table II, the heart catecholamine content (µg/g) of the wild rats was reduced by 30% when compared to the grey lab rats. As indicated, the total heart proteins of both groups were identical.



●, represents wild grey *Ratus norvegicus*. $y = 60.28 + 3.22\,x$ ($\sigma = 90.7$).
○, represents lab grey *Ratus norvegicus*. $y = 57.68 + 2.52\,x$ ($\sigma = 74.4$).
▲, represents totals, $y = 61.46 + 2.81\,x$ ($G = 99.4$).

No correlation could be detected between the heart to body weight ratio and the catecholamine content (µg/g) for the lab grey rats ($r = 0.02$) and the wild animals ($r = -0.17$).

Discussion. Years ago, CLARK[13] drew a parallel between the heart weight of the hare, considered as a naturally exercized animal, and the domesticated rabbit living in confined conditions. Though these animals differ genetically, this study indicated the relative heart hypertrophy in the physically trained species. Most of the laboratory experiments dealing with this subject have concerned domesticated animals, mainly albino and hooded rats. As previously mentioned, these experiments are artificially created.

It is very likely that the wild grey rats living in nature have a life occasioning more vigorous exercise than the ones born and reared in confinned cages. Struggle for dominance inside the group, fighting for territorial supremacy and satifying needs for food, are certainly motivations resulting in activities – assimilable to excercise – which do not exist to the same extent in the laboratory raised grey rats[14]. In our experiments, though the heart and the body weight of the 2 groups of animals were approximately the same, the heart weight/body weight ratio was statistically different. In order to eliminate eventual body weight variations which might invalidate this ratio[15,16], we performed a covariance analysis indicating that the hearts of the wild rats compared to their body weight were heavier than the ones of the lab rats. As seen in Table II, the heart catecholamine content of the wild rats were significantly lower when compared to the cardiac catecholamine content of the lab rats. Since no correlation could be found between the heart to body weight ratio and the catecholamine concentration, the significant cardiac hypertrophy detected by this ratio and confirmed by covariance analysis is probably very slight and cannot explain the reduction of the catecholamines as a dilution of the neurotransmitter. The total heart proteins of both groups were identical, so that we may consider that cardiac edema is not the cause of the reduced catecholamine levels. This data confirm previous studies performed by us on albino rats physically trained in a rotating drum[7]. The cardiac catecholamine content accused about the same reduction of 30% from the controls in our chronically exercized albino rats. It is tempting to suggest that the activity, whether spontaneously occuring in nature or created artificially in a laboratory as physical exercise, would produce the same effect on the sympathetic transmitter content of the myocardial tissue.

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Résumé. Le taux des catécholamines du myocarde a été dosé chez le rat sauvage vivant dans la nature et chez le rat de la même espèce vivant dans des conditions de confinement en laboratoire. Chez l'animal élevé en laboratoire le taux des catécholamines est significativement plus élevé que chez son homologue vivant dans la nature.

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Thermoregulatory Pheromones in Wasps

Wasps and hornets (family Vespinae) are widespread throughout the Northern Hemisphere. The more familiar social species belong to the subfamily Vespinae[1,2]. Thermal measurements taken within the nests of various species have shown that the temperature is maintained at quite a constant level[3-6]. This work has been done to understand how the temperature regulation is maintained.

Material. Temperature and thermoregulation were studied using groups of adults or single pupae and larvae of the following species: *Vespa orientalis* (VO), *V. crabro* (VC), *Paravespula germanica* (PG), *P. vulgaris* (PV), *Dolichovespula saxonica* (DS), and *D. media* (DM).

Methods. Groups of 50–200 wasps or hornets were kept at room temperature (18–25 °C) with and without brood combs within boxes having glass coverts to enable observation. Temperature of wasp clusters or single pupae or larvae was measured with a platinum thermoelement (5 mm × 3 mm, Degussa, Hanau) and recorded with a Punktschreiber (Hartmann and Braun). Observations were made on the behaviour of wasps in clusters as well as toward brood combs, pupae and larvae which were removed from the combs. Various stages of wasps and several other species of insects, social and non-social were extracted either in tap water, acetone aether or 70% ethyl alcohol. Strips of filter paper impregnated with the above extracts, freeze dried as well as wax or plastic replicas of pupae have been examined for their thermoregulatory triggering effect on wasps. Pupae were incubated in thermostat at 20 °C and 32 °C (60–70% humidity) in order to study the influence of the temperature on their maturation.

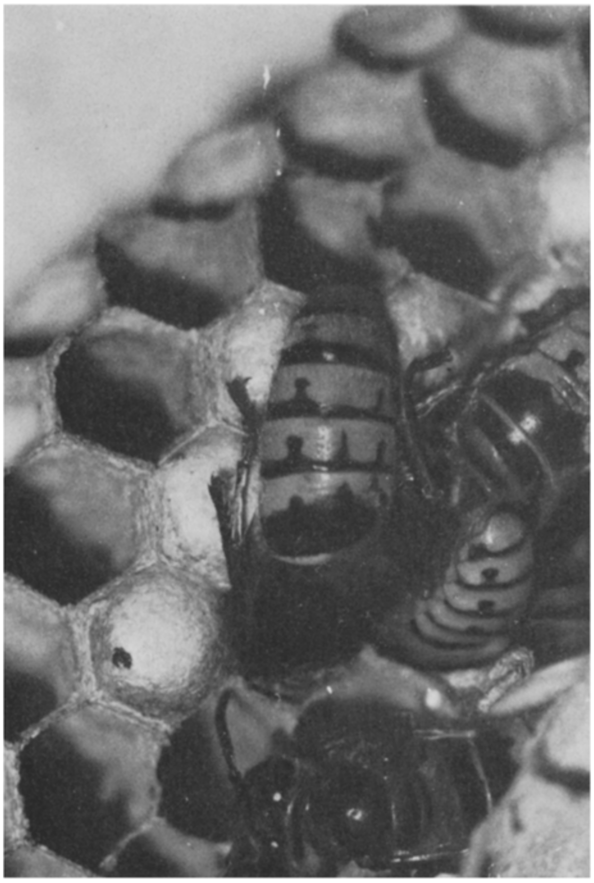

Fig. 1. Workers of *Vespa crabro* on the comb in the usual position when warming pupae. Photo: Mr. U. Eidam.

Results. Groups of wasps, PG, PV, DS and DM, tend to congregate in tight, multilayered culsters in the lower corner of the box. Once they form a cluster, the wasps start rapid abdonimal pumping movements by alternatively retracting and extending the abdominal segments at a rate of up to 180 movements per minute. Hornets, VO and VC form a single-layered cluster in the uppermost part of the box and just like the wasps, exhibit constant abdominal pumping movements. The temperature reading amidst the wasps was usually 29–35 °C as compared to 23–25 °C measured within the box.

Wasps or hornets which were offered a comb belonging to their own species and containing brood (i.e. eggs, larvae and pupae) in the normal position (cell opening downwards), rapidly occupy the comb, some of the workers enter vacant cells adjacent to a pupa, place their abdomen against the cocoon and commence the abdominal pumping movements (Figure 1). Within 5–7 min they raise the temperature of the pupa to 30–32 °C as compared to 20–22 °C outside the comb. In no instance were workers observed to warm the larvae or the eggs. Temperature readings on unwarmed individual pupae, intact within their cocoon, do not differ from that of the immediate environment. In contrast, the temperature of unwarmed individual larvae slightly exceeds (by 2–3 °C) the environmental temperature (Figure 2). When pupae are removed from their cocoons through the upper surface of the comb (so as not to damage the silk dome), the workers will cease warming the empty cocoons. If a pupa is removed from its cocoon and placed in the midst of a group of wasps

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